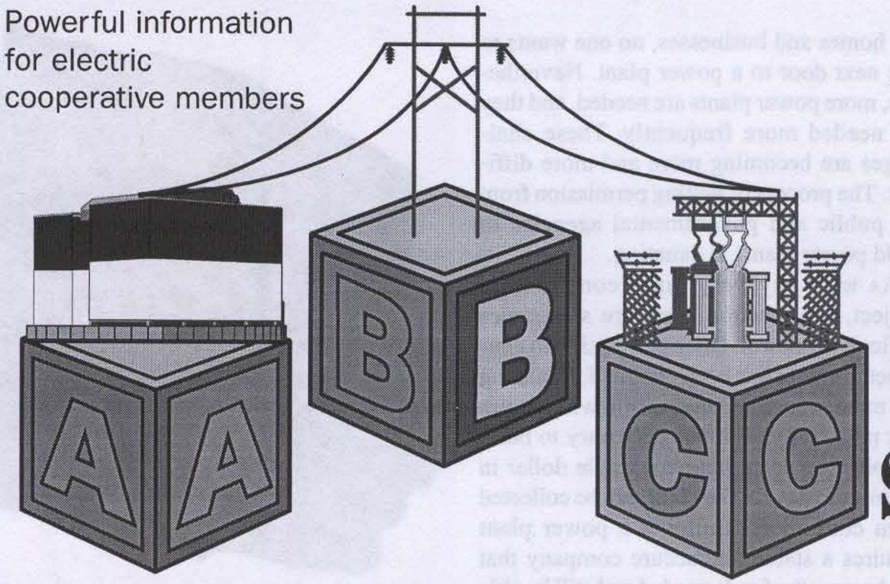
Co-op Power

Powerful information for electric cooperative members

Power's ABCs



First in a three-part series about how electricity is produced, transmitted and delivered to cooperative members

By David Logeman, Contributing Writer

Every time a cooperative member flips a light switch, three kinds of service come into play to make electricity turn on the lights. First, the electricity itself has to be created, or generated, in a power plant. Secondly, it has to be transmitted long distances, at high voltages, and delivered to a substation. There, thirdly, it has to be transformed back to a lower voltage and delivered to the member's home where the switch is flipped. This very simplified example demonstrates the process necessary to produce and deliver power for use in homes, and businesses, and factories throughout our state.

In this three-part series of articles, we will look at each of the steps necessary to deliver electricity to cooperative members and some of the issues and challenges surrounding them. The first installment in this series talks about the generation of electricity to meet the projected needs of a growing South Carolina.

Generation of electricity, in simplest terms, is the conversion of the energy contained in a fuel to electricity. This fuel can be a fossil fuel such as coal or natural gas, or it can be another type of fuel such as uranium, or even the energy stored in wind and water. In all of the fuels listed, all of them except wind and water are used to create heat. This heat in turn boils water, which then creates steam. The steam is then used to spin a turbine which creates the electricity in a generator. In a manner of speaking, generating electricity is all about boiling water. In the case of hydroelectric generation, water, of course, isn't burned. Water essentially falls through a turbine to create the motion necessary to spin the turbine, much in the way falling water turns a water wheel. What is common for all of the methods by which electricity is generated is the spinning motion, needed to turn the magnets inside the wiring of the generator to produce electricity. Many remember hand-crank generators and even telephones that were activated by a crank mechanism. The purpose of that crank was to produce the first small amount of electricity necessary to carry the voice signal to the telephone operator. Today's electric generating plants, producing billions of watts of power, are in many ways gigantic versions of those old crank generators.

David Logeman

Except for a relatively small but growing amount of renewable energy from wind, solar, landfill gas and other sources, electricity is primarily generated in fossil fuel plants burning either coal or natural gas. Nuclear power makes up about 20 percent of the power generated in the United States and a significant portion of the power generated in South Carolina. When looking at the fuels used to produce power for the electric cooperative system in South Carolina, the primary fuel is coal. Coal generation accounted for about 78 percent of the average of 1,805 megawatts of power consumed by cooperative members in 2005. A megawatt is about enough power for 250 homes. Virtually tied for second place were natural gas and nuclear at around 10 percent each. The remainder of the power came from hydroelectric facilities, and even some renewable resources such as landfill gas.

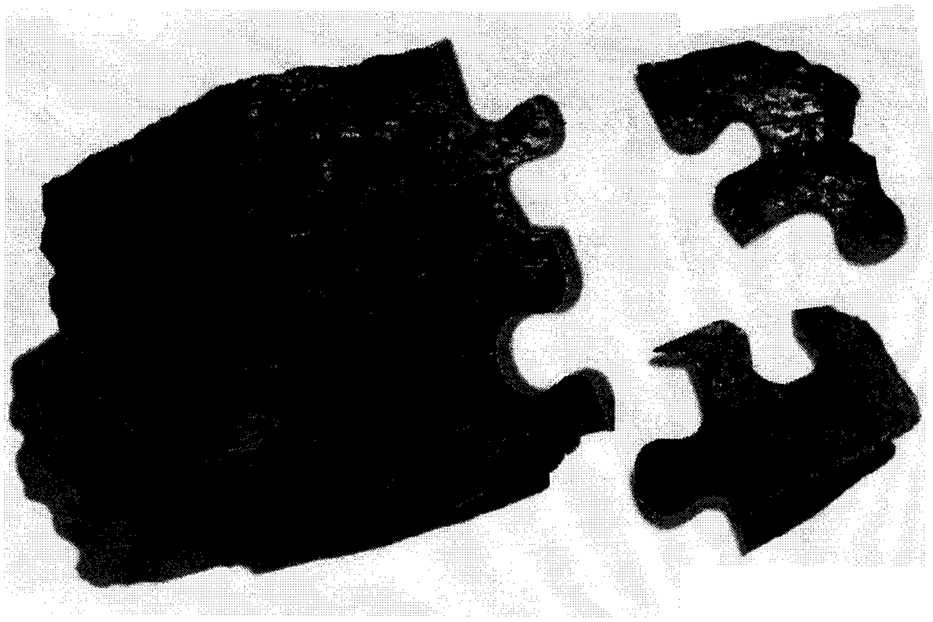
As you might expect, building power plants is increasingly challenging and expensive. The challenge lies in piecing an intricate puzzle of tangibles, such as land, steel and concrete, together with intangibles, such as predictions relating to future costs of fuel — all to determine the best value for consumers. For a typical plant under construction, the cost of choosing a site, permitting, and construction can run more than $1 billion. And these costs are rising. To further complicate the picture, the time it takes to build a power plant can range from six to 15 years.

Planning for demand

Cooperatives are looking ahead and making plans to meet power requirements for the next 20 years and beyond. Long-range planning is constantly under way to ensure that power will be there when needed to meet future peak electrical demand, which last year exceeded 3,360 megawatts on the hottest day and 3,200 on the coldest day.

Land is becoming ever more expensive. The task of acquiring a new power plant site is more difficult every day. Power plants are big, and they require large spaces to operate. They need to be situated near bodies of water or rivers so that the water can be used as cooling for the production process. The availability of roads and, sometimes, rail is essential. And finally, while all of us are requiring more and more electricity to run our homes and businesses, no one wants to live next door to a power plant. Nevertheless, more power plants are needed, and they are needed more frequently. These challenges are becoming more and more difficult. The process of getting permission from the public and governmental agencies to build power plants is daunting.

As with any very large construction project, construction costs are sometimes difficult to control. Once permission to construct the plant has been obtained, financing has to be secured. Construction will require that practically all funds necessary to build the plant be spent before a single dollar in revenue, to pay for the plant, can be collected from consumers. Building a power plant requires a stable and secure company that can borrow the funds needed and still be able to pay debt obligations to its bankers and consumers.



"The challenge lies in piecing an intricate puzzle of tangibles, such as land, steel and concrete, together with intangibles, such as predictions relating to future costs of fuel..."

Choices, choices

Once a plant has been built and is ready for operation, the last piece of the puzzle has to be placed. The fuel to be consumed in the plant has to be delivered. Whether it is natural gas, coal, uranium, or an alternative fuel such as landfill gas, the fuel has to be procured. Each has its own unique advantages —and problems. In the case of nuclear power, the most obvious challenge lies in the very nature of the fuel itself. Uranium is radioactive. Secondly, after it's been used and needs to be replaced, it's no easy task to refuel a nuclear power plant. And then there's the waste problem. On the plus side, however, for the amount of heat that can be generated per unit of fuel, nuclear is inexpensive compared to coal, and especially to natural gas. Other than water and wind, where the cost of the fuel is essentially free, there is no cheaper way to generate electricity than nuclear power on a fuel cost per unit of electricity generated. On the other hand, there is no more expensive power plant to build than a nuclear power plant. Capital costs have, over the past thirty years or so, more than offset the fuel savings of nuclear power. As coal and gas prices have risen dramatically, and with the mounting costs and problems associated with all fossil fuels, many electric utilities, including those in South Carolina, are considering construction of new nuclear power plants. That's striking when you consider that a new nuclear power plant has not been built in this country for more than thirty years. Nuclear power plants are, however, being built in many parts of the world including both Europe and Asia.

Fossil fuels such as coal and natural gas pose additional concerns other than raw resource costs. Cleaning up greenhouse emissions and other environmental considerations are driving up the costs of building and operating these types of plants. Changes in federal law pose challenges. Coal costs are rising dramatically as power companies compete for higher qualities of coal in order to meet increasingly more stringent mandates for emission standards for limiting sulfur dioxide and other emissions. Power companies who have large needs for coal generation can buy emission allowances, in a competitive market, from companies who do not need them. The cost of these allowances follows the law of supply and demand, and they are in great demand. The 2006 cost of allowances for the cooperatives' power supply will more than double from 2005 levels. Add that to higher coal prices. The dramatic rise in coal and allowance costs is having a major impact on the price electric cooperatives pay for wholesale power.

Renewable alternatives

Currently, two new coal-fueled plants and smaller landfill-gas-fueled "Green Power" plants are being built to serve the power needs of your electric cooperative. The coal-fired plants are on existing sites and will be outfitted with advanced environmental safeguards. The first of these units will be available for use in 2007 and the second one, in 2009. The new Green Power plants complement a growing mix of alternative energy to help meet consumer demand. Members who buy Green Power do so voluntarily, and its added cost supports the development of alternative energy in South Carolina. Cooperatives are looking ahead and making plans to meet power requirements for the next 20 years and beyond. With construction lead times of six to 15 years, long-range planning is constantly under way to insure that power will be there when needed. New technologies such as offshore wind generation, solar, hydrogen fuel cell and other energy sources are being explored. Costs are being weighed to try and assure that whatever future prices of power production may be, we are delivering the most lowest-cost power possible and serving the needs of cooperative members judiciously.

David Logeman is Director of Power Supply for Central Electric Power Cooperative, which transmits and provides power generated by the state-owned utility, Santee Cooper, and others, to your electric cooperative. He lives in Columbia.

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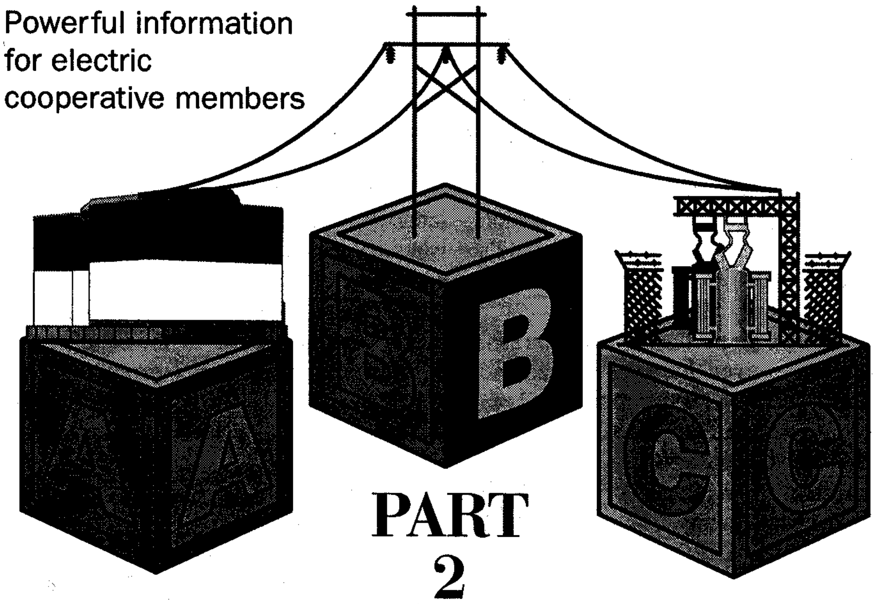

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PART 2

Second in a three-part series about how electricity is produced, transmitted and delivered to cooperative members

By David Logeman, Contributing Writer

Just how does electricity move around? How does it get from the point where it is generated to the point where it's consumed?

In the first of a three-part series of articles on where power comes from, last month we looked at the generation of power. In this article, the second in the series, we will look at how electricity moves from a generator across a network of high-power transmission lines to substations where the voltage is lowered. Next month, we will see how power ultimately is distributed to homes and businesses.

Birth of a network

In 1879, Thomas Edison produced the first practical light bulb that would last longer than a minute or two. Only three years after demonstrating his incandescent bulb, Edison opened the Pearl Street station in New York City. This station was the world's first commercial power plant. Once the light bulb had demonstrated the practical use of electricity, and the power station had been built, a path had to be created to get the electricity from the power station to power users. This path and others like it would ultimately become the network of power lines connecting power plants to consumers all over America.

A power plant produces electricity at about 25,000 volts. While 25,000 volts may sound high, it's really not. In order to move power efficiently on a transmission system, the voltage is boosted in order to move long distances. On the Central-Santee Cooper transmission system, power is transmitted at either 115,000 or 230,000 volts. Some older transmission lines operate at 69,000 volts, but all of the transmission lines being built today operate at either one of the two higher voltages. Delivery of the high-voltage power is made at the cooperative's substation. Within the substation, the voltage is lowered and moved through the distribution system where it is lowered one last time at either a pole-mounted or pad-mounted transformer to a voltage useable in the home or business.

One truly remarkable fact becomes apparent about the transmission system owned and operated by the electric cooperatives. The cooperatives have built the only true statewide transmission system in South Carolina. From its beginnings in 1948, when 14 electric cooperatives formed Central Electric Power Cooperative to transmit bulk electric power to their systems, this 2,511-mile network of transmission lines covers much of the lower two-thirds of South Carolina. Coupled with 2,390 miles of line owned and operated by Santee Cooper, a system totaling 4,901 miles constitutes the state's largest transmission network. In fact, much of the transmission system that was originally built by Central, especially in the early years, has been leased to Santee Cooper to operate and maintain as part of what is referred to as the bulk power system.

David Logeman

The South Carolina Public Service Authority began in the 1930s as a project to improve navigation and flood control along the Santee and the Cooper River systems. Hence the name, Santee Cooper. As a part of the project, hydroelectric generators were installed to produce electricity. During World War II, additional generating capacity was constructed to assist in the war effort. Once the war was over, Santee Cooper was looking for a market for the power. Coincidentally, the electric cooperatives were growing rapidly. A partnership between the cooperatives and Santee Cooper seemed beneficial for all. Central Electric Power Cooperative was formed in 1948 to transmit Santee Cooper's power to the electric cooperatives. This partnership has lasted well over 50 years and has benefited South Carolina tremendously.

In 1958, five electric cooperatives in the Upstate formed Saluda River Electric Cooperative to provide roughly the same service for those systems. The reason two transmission cooperatives were formed was partly due to geography. The cooperatives in the lower part of the state had been buying their power from either Santee Cooper or South Carolina Electric and Gas Company directly, under contracts negotiated individually between each of the cooperatives and those companies. The five cooperatives in the upstate were buying their power from Duke Power Company. At the time, it made sense to form separate companies due to the preferences in how the two systems wished to purchase wholesale power. Today, New Horizon Electric Cooperative, an offshoot of Saluda River Electric Cooperative, provides transmission service to Upstate cooperatives over a system of 126 miles of transmission lines. This system is interconnected with the Duke system to provide true network service to cooperatives throughout the Upstate. In 1999, Central and Saluda River agreed to unite into one generation-and-transmission cooperative to serve all 20 of the state's distribution systems. That process will be completed by early 2009.

As you might guess, the transmission system has grown over the years in size and complexity. No major transmission grid operates in a vacuum. The cooperative-Santee Cooper system is interconnected with Duke Power, Progress Energy, South Carolina Electric and Gas, the Southern Company and others. These interconnections allow companies to buy and sell power to each other, and, also, to provide additional reliability as one system can back the other up during an emergency. But as these interconnections have had real benefits, they have also presented challenges.

The greatest challenges of building and operating transmission grids have often centered around cost. It is quite expensive to construct transmission lines. The costs of wires, structures, land and rights of way to place the lines all are increasing. More importantly, they are becoming more difficult to obtain. South Carolina's population has grown to the point that it is becoming more and more difficult and costly to route new transmission lines around populated regions. Extra care must be taken if lines are to be built, if at all, in environmentally sensitive areas. An ever-increasing appetite for power, often in undeveloped areas, challenges cooperatives to provide reliable electric service. No one, including your electric cooperative, wants to damage the environment or disturb cultural or historically significant places. Cooperatives do everything within their ability and control to protect these precious resources. The fact remains that cooperatives have an obligation to provide power to an increasing population and a growing economy. Balancing these needs takes a great effort and a solemn responsibility that cooperatives do not take lightly.

File

A new transmission line awaits completion along South Carolina's fast-growing coast.

Most of these challenges are ones that cooperatives have faced before. The whole electric utility industry, however, has undergone some pretty radical changes since the 1990s. Perhaps you remember the debates regarding deregulation of the electric power industry. Fortunately, the South Carolina legislature decided to take a go-slow approach and allow other states to experiment with power deregulation. Generally, these experiments have not produced the benefits that deregulation proponents promised. The debate over the pros and cons of a truly open and competitive electric energy market continues. Once a model demonstrates true and real benefits to all members, then cooperatives will endorse it. Until then, we'll just wait and see — and learn from the mistakes of others.

As a part of deregulation, the Federal Energy Regulatory Commission (FERC) changed the rules for how companies handle their transmission assets. The push was to open access to the bulk transmission system and help foster a deregulated wholesale market. In some states, electric companies divested themselves of their transmission assets to third parties. Regional Transmission Organizations (RTOs) were formed to provide an open-access highway for all suppliers of electric power from traditional electric utility companies to independent power producers, to produce and sell power in an open market.

Experts continue to debate how successful this experiment has been, but the point it illustrates is how different the challenges have become. Twenty years ago, no one expected change of this nature. The transmission systems built by each operating company were constructed to meet the needs of that company. Interconnections were made for the convenience of the companies but were operated to the benefit of local consumers. After all, that's exactly what state and federal regulators had always wanted, and the power companies had done a good job in providing it. Frankly, the nation's transmission grid was never intended to serve as an open-access highway for power and was ill suited for that purpose.

There will be more debate regarding the makeup and the character of the nation's critical electric infrastructure. The electric cooperatives of South Carolina are monitoring and actively participating in the debate. As we discuss these issues in various forums, we are always mindful that cooperatives exist only for the benefit of the members. Cooperatives will not be looking for ways to influence the conversation so that they might be able to "game the system" to our advantage for the benefit of a few.

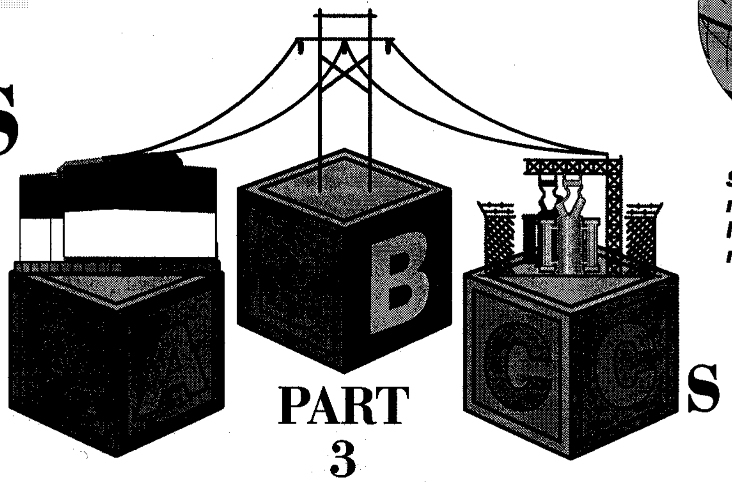
Cooperative promise

There is no way to know the future or what it might bring, and, as the Greek philosopher Heraclitus said, "Nothing endures but change." But as certainly as circumstances will change, what will not change is your cooperative's commitment to providing safe and reliable electric service at lowest possible cost in keeping with sound financial and environmental practices. From the generating station, through the transmission grid, and finally through the local distribution system to the ultimate consumer, your electric cooperative systems are meeting today's challenges and planning for the future.

David Logeman is director of power supply for Central Electric Power Cooperative, which transmits and provides power generated by the state-owned utility, Santee Cooper, and others, to your electric cooperative. He lives in Columbia.

South Carolina's co-op network has enough lines to wrap the Earth more than 2½ times.

Power's



Third in a three-part series about how electricity is produced, transmitted and delivered to cooperative members

By David Logeman and John Bruce

Just how does electricity move around? How does it get from the point where it is generated to the point where it's consumed?

The first installment of this three-part series of articles, on where power comes from, looked at the generation of power. The second article examined how electricity moves from a generator across a network of high-power transmission lines to substations, where the voltage is lowered. This third and final article looks at how power ultimately gets distributed to homes and businesses of cooperative members.

An explanation of electric power distribution would be incomplete without an insight into its remarkable history. The previous article in this series mentioned Thomas Alva Edison's part in the pioneering of electric power. But it was not Edison who made your electric cooperative's power distribution grid possible. In fact, today's system of power distribution came about largely in spite of Edison.

Power's *real* hero

Inventing the light bulb was one thing, but getting electricity to a home was another matter entirely. Edison's direct current (DC) system of power distribution was riddled with problems. DC power lines longer than a mile were impractical. Edison's system was good for little more than powering light bulbs. DC lights and DC motors required separate power lines. If Edison's original power delivery grid had gone on as he had intended, the result would have been disastrous. A tangled spaghetti pile of power cables and generators would crowd the world in a tremendously dangerous waste of money and space.

In 1884, five years after inventing the light bulb, the demand for power was booming. Edison believed he needed someone to redesign the Edison Company generators. On recommendation from an associate in Europe, Edison hired one Nikola Tesla, a 28-year-old Serbian immigrant. Four years earlier, after graduating from one of Europe's most prestigious polytechnic schools, Tesla had conceived the idea of "polyphase" electric power. With electrons flowing in alternating phases, or waves, of current, Tesla's alternating current (AC) power system would forever change the world.

Nikola Tesla

Even as he hired Tesla, Edison scoffed at the notion of AC power. Legend has it that Edison offered Tesla $50,000 for the job of redesigning his generators. Tesla worked on the project about a year before becoming the butt of an Edison joke. When Tesla told Edison his job was completed, he asked about his money. Edison offered Tesla a $10 weekly pay raise instead of the $50,000. "You don't understand our American humor," Edison told Tesla. Furious, Tesla resigned without notice.

Tesla's inventions including the AC power distribution system within four years had won the most valuable patents since the telephone. His most famous invention was alternating current (AC) power, which made practical the long-distance distribution and delivery of electricity, the lifeblood of modern civilization, to homes and businesses. Little did Tesla know then that his work would make electric cooperatives possible.

Current competition

As Tesla's first AC system was first being demonstrated, Edison, who was not to be outdone, was pouring considerable resources into a futile promotion of his DC current. He went so far as to wage a bizarre public relations campaign to disparage AC power by staging electrocutions of stray cats and dogs — once even an elephant — before members of the press. Ironically, Edison had opposed the death penalty, but he was so obsessed with debunking Tesla and George Westinghouse, who sold Tesla's AC power system, that the Edison Company went on to invent an AC electric chair to persuade the public to believe that AC was deadlier than DC.

Edison was too late. Tesla's AC power was starting to become America's electric power standard. The Tesla system won the contract for the world's first hydroelectric project against other systems, including Edison's. Tesla had envisioned harnessing Niagara Falls as a child growing up in what is now Croatia. Tycoons with names including Astor, Morgan, Rothchild and Vanderbilt backed the project, which was fraught with doubt (to everyone except Tesla) up to its completion in 1896. At midnight on November 16, commercial AC power was delivered for the first time. The first block of power went to the streetcar system of Buffalo, New York, some 20 miles away.

Soon, the Niagara Falls Project was complete. AC power soon reached New York City. Nights on Broadway were now bright with AC-powered lamps. Streetcars and subway trains purred with the power of AC motors. Even Edison's DC systems converted to AC power. The role of DC power now was relegated to use in cars, trucks and electric appliances.

Electricity in South Carolina would first flow to textile mills in the Upstate. In 1897, the world's first electric cotton gin powered up in Anderson County. The county seat of Anderson gained the nickname, "The Electric City," which it still holds. The city was the first in the state to sell power to light up homes and businesses.

The picture was not as bright elsewhere in the Palmetto State during those days. Utilities knew they could not profit by running lines into the countryside where homes were so far apart. Power companies were connecting 25 or more city homes per mile of line. There would be only about five per mile outside the city. Without laborsaving devices made possible by electricity, the standard of living throughout most of the state continued much as it had during the 19th century and the decades of poverty, hunger, sickness and misery after the Civil War.

People living in these vast reaches of South Carolina realized that the only way to get power in their homes was to bring it themselves. They created a new kind of electric service provider, called an electric cooperative, which procures power and delivers it to its members. Seeds of the first electric cooperative in South Carolina sprouted during recovery from the Great Depression. In 1937, four decades after power reached Anderson County, people in Aiken County began meeting to learn how to get lights in their homes.

Aiken Electric Cooperative energized its first line on November 8, 1938, to provide the first co-op electric service in the state. Munson Morris, the first president of Aiken Electric Cooperative, was a friend of President Franklin D. Roosevelt, whose New Deal paved the way for South Carolinians to organize electric cooperatives. By the early 1950s, electric cooperatives had begun serving members in every county in South Carolina. Today, more than 1.3 million South Carolinians receive power from the state's 20 electric cooperatives, which operate the largest electric distribution network in the state with more than 66,000 miles of lines.

Electric cooperatives use Tesla's polyphase system as a means of distributing AC electric power. The most common examples of polyphase systems are single and three-phase power systems used in homes, small businesses and large industries. Wooden poles and buried cables support a grid of wires and other equipment to deliver safe and reliable electricity. On a pole or concrete pad, transformers are used to reduce the power's voltage. The higher the voltage, the farther power can be transmitted. But electrical devices can use power only at lower voltages. A distribution system transformer steps down the voltage from distribution levels, usually 7,200 volts, to voltages used in a home or business, usually 120 volts.

File

A newly installed transformer box in fast-growing Horry County is one of thousands of pieces of equipment that cooperatives install yearly to keep pace with population growth.

Your co-op's role

Your cooperative follows a strict regimen of business practices to ensure that your electric service quality remains consistently high. For instance, a planned program of vegetation control and right-of-way maintenance helps prevent outages by keeping tree limbs away from power lines. Cooperative members are encouraged to help keep the lights on by allowing authorized personnel on their land to carry out this program. The cooperative conducts consumer research and employs new technologies to meet member needs. Gathering information on members' appliances enables the cooperative to custom-build and update the power distribution system. The cooperative is dedicated to ensuring that power flows to members safely, efficiently, reliably and at the lowest possible cost.

South Carolina's population growth poses special challenges. Cooperatives are growing at more than twice the rate of investor-owned utilities but serve a far lower density of consumers. Poles, wires, transformers and underground cable and all the other equipment needed to support Tesla's AC power distribution system must be economically priced so as to keep costs down. A specialized equipment purchasing cooperative, Cooperative Electric Energy Utility Supply (CEE-US), provides at-cost distribution system materials and services to electric cooperatives.

Because your electric cooperative is member-owned and not-for-profit, it works together with other cooperatives through state and national entities to pool their resources and hold down costs. Examples include The Electric Cooperatives of South Carolina and National Rural Electric Cooperative Association. Another example is a cooperative financial institution, National Rural Utilities Cooperative Finance Corporation, which provides low-cost financing for cooperatives to operate and maintain Tesla's AC power distribution system.

Half a decade after co-op electricity arrived in South Carolina, Tesla died at age 86. He was destitute, despite having earned 275 patents in 25 countries, including his "System of Electrical Distribution," which was patented May 1, 1888, in the United States.

The year 2006 marks the anniversary of Tesla's 150th birthday. Happy birthday, Niko.

David Logeman is director of power supply for Central Electric Power Cooperative. John Bruce is the editor of this magazine. To learn about Tesla and his inventions, log onto www.pbs.org/tesla/index.html and http://en.wikipedia.org/wiki/Nikola_Tesla. For information on electric cooperatives, log onto www.ecsc.org.